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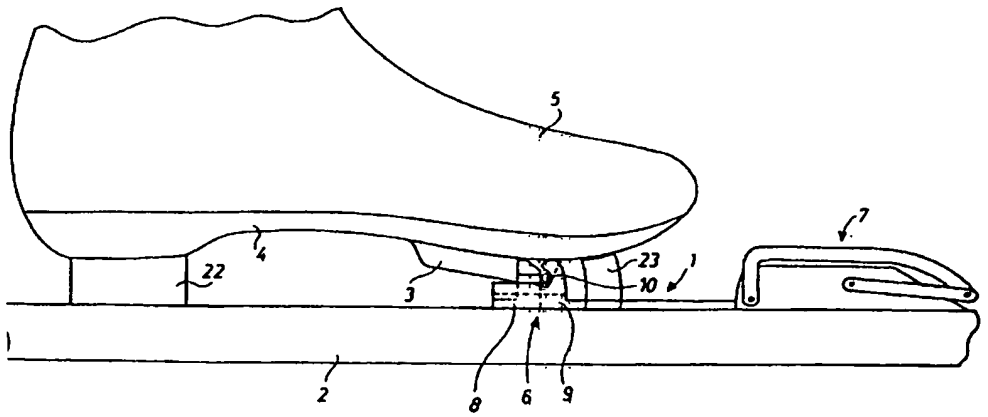

(57) Abstract: The invention involves the sole-gripping safety binding including the shoe with adjustable lateral inclination for cross-country skiing.The sole-gripping safety binding including the shoe with adjustable lateral inclination for cross-country skiing allows for shifting of the shoe (5) gripping point from the tip towards the centre of the sole (4) of the shoe (5), whereby the sole (4) is lifted above the ski (2). The shoe (5) is provided on its sole (4) with a conical gripping element (3) including the axle (10) that is shifted towards the centre of the sole (4); the latter is provided with a distance piece (22) under the heel part of the sole (4) and with a flexor (23) under the toe part of the sole. The axle (10) makes a grip with the base (6) of the binding (1), while the part (9) of the base (6) is connected with the tightening element (7) of the binding (1).

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SOLE-GRIPPING SAFETY BINDING INCLUDING THE SHOE WITH ADJUSTABLE LATERAL INCLINATION FOR CROSS-COUNTRY SKIING

The invention refers to the sole-gripping safety binding including the shoe with adjustable lateral inclination for cross-country skiing. The invention has been classified as class A 43 B 05/04 of the International Patent Classification.

The technical problem successfully solved by the invention in question is how to provide for the best possible push-off at cross-country skiing as well as for an optimum lateral stability at the push-off. The technical problem further extends to the manufacture of such cross-country skiing shoe where the lateral inclination will be adjustable. The third technical problem successfully solved by the invention is concerned with the safety of the binding that will get released in the event of excessive strain accompanying the falls, so as to reduce the risk of injuries at falling.

With all currently existing and commercially available designs of cross-country skiing bindings the shoe gripping point is located at the tip of the shoe.

Older versions were provided with a prolonged sole at the front that used to serve for gripping the shoe. The prolonged part was flexible, thus allowing for lifting of the heel of the shoe, such as required for easier cross-country skiing. These versions, however, involved several problems. First the prolonged part of the sole was not flexible enough, which made the lifting of the heel more difficult. Due to constant bending, the prolonged part of the sole used to be exposed to much strain, therefore the material tended to crack in the foldings.

The next generation of cross-country skiing shoes has no sole prolonged at the front; instead it is provided with an axle fixed on the sole of the shoe under the first toe that gets caught by the binding fixed on the cross-country ski. The axle is parallel with the shoe sole and with the upper surface of the ski and it is mounted in the way that the shoe turns around it lengthwise with reference to the ski.

In particular with the skating technique of cross-country skiing it is very important to provide for lateral stability of the skiing shoe in the gliding phase when the shoe fits to the binding with its entire sole and in the push-off phase, accompanied by lifting of the heel of the shoe. Till now this problem used to be solved by the application of rigid materials that reduced longitudinal twisting of the shoe and improved its lateral stability;

yet, its bad consequence was that such shoe was not much flexible over the toes, which is necessary for natural cross-country skiing. Certain manufacturers tried to solve the problem of longitudinal twisting by mounting an additional axle, located in the sole of the shoe behind the first one, which, however, partly reduced the longitudinal twisting of the shoe, although at lifting of the heel in the push-off phase the axle remained located at the same place, at the front of the sole below the first toe.

Another weakness of the binding provided for front gripping appears in the push-off phase of cross-country skiing. Both cross-country skiing techniques, the skating and the diagonal one, consist of two phases: the gliding phase and the push-off phase. The push-off phase on one leg is first followed by the gliding phase on the other leg that passes into the push-off phase on the other leg and back on the first leg, first gliding, then push-off. The push-off phase consists of two parts. In the first part of the push-off the sole the sole fits to the cross-country skiing binding all along its length and in this part the gripping point is not important. In the second part of the push-off, the heel section of the shoe is lifted and the shoe turns around the gripping axle at the front of the shoe. In this phase the cross-country skier pushes off by his toes and not from the point in that part of the sole that covers the metatarsofalangeal joint where the push-off is the most intensive. Therefore the push-off is less explosive.

The solution of the above problems is described in the patent No. US5664797 where the shoe gripping point is transferred back, under the sole. The problem of this solution lies in the fact that in the last push-off phase, on lifting of the heel section of the shoe, it is almost impossible to lift the back part of the shoe. The back of the shoe may only be lifted as much as the shoe can bend from the gripping point backwards. The flexor located further from the gripping point also gets squeezed, although, due to the too low gripping point, it is still not enough for normal cross-country skiing.

Another solution is described in the patent WO 0010413 where the gripping point is moved backwards as well. In order to provide for sufficient lifting of the heel in the last part of the push-off, the shoe described hereunder has been curved upwards for at least 30° from the gripping point on. Therefore the shoe, however, can be lifted, but is anatomically completely unsuitable. Another weak point of this version lies in the fact that it requires a rigid sole, which is also not suitable for cross-country skiing.

None of the commercially available and applied cross-country skiing bindings is a safety binding, which means that it does not get released under high strain. Compared to the downhill, cross-country skiing involves less speed and the shoe is free in one dimension with reference to the ski, because it turns around the gripping axle; accordingly cross-country skiing does not involve so much need for safety binding. In the event of

more severe falls the skier may get injured or his ski may break nevertheless because the existing bindings do not get released anyway, except when opened manually.

With the skating cross-country skiing technique it is favourable that the sole of the shoe is not parallel with the upper surface of the ski, but is bent outwards, so that the skier in his upright position stands with his legs "o-shaped". The advantage of the inclined sole is evident in the push-off phase. The ski needs to be placed on the internal edge, so that at the push-off the ski does not glide aside. The skier achieves it by pushing his knee inwards. Due to the inclination of the sole, the ski in positioned on its edge from the very beginning and the knees need not be pushed inwards as much as it is the case with the parallel position of the shoe and the ski. The solutions hitherto have solved the inclination with an inclined base or with a binding that is itself inclined. The weak point of this solution is that such ski can only be used on one leg.

All cross-country skiing bindings that use the axle on the skiing shoe are designed in the way that the axle is fixed to the shoe in two points, on the left and on the right edge of the sole. The binding makes an grip with the axle between its left and its right gripping points. For better lateral stability, the longest possible axle would be favourable, but with the shoes where the axle is fixed on the outer edges, the length of the axle is limited with these edges.

The above described technical problem is solved with the sole-gripping safety cross-country skiing binding and with the corresponding cross-country skiing shoe with adjustable lateral inclination. The essence of the proposed solution lies in the fact that the gripping point is transferred under the sole to the point where the push-off is the most powerful. The rotation axle and the shoe are lifted above the ski as much as that in the last phase of the push-off the heel of the shoe can be sufficiently lifted without bending the front of the shoe upwards. The sole of the shoe is flexible and, if necessary, bends in the last phase of the push-off, so that the heel sufficiently lifts above the ski. The cross-country skiing shoe is designed in the way to allow for adjustment of the lateral inclination of the shoe sole with reference to the axle that makes a grip with the safety binding in the sole. The grip of the cross-country skiing shoe with the safety binding is such that under excessive strain the shoe gets released.

Due to the transfer of the gripping point under the sole, all technical weaknesses in connection with the gripping on the front of the shoe disappeared. With the sole-gripping safety binding, the sole of the cross-country skiing shoe that tends to twist at the lateral inclination of the foot is shorter than with front gripping bindings; accordingly, at the push-off the cross-country skiing shoe is much less prone to twist. For the above reason the force is much more directly transferred from the skier's foot to the ski. This is particularly important in the push-off phase of the skating step when the cross-country skier bends his foot inwards to place his ski

on the edge and thereby to get a support for the push-off. Due to better torsional stability, the ski is placed on the edge with less inward inclination of the foot, which requires less energy, while the foot remains in a more natural position for the push-off. As a result, the push-off is more explosive.

The invention will be explained in detail on the basis of the concrete example and the corresponding pictures, whereof:

Figure 1 shows the side view of the assembly that consists of the sole-gripping safety binding and of the cross-country skiing shoe with lateral inclination, such as referred to in the invention;

Figure 2 shows the front view of the sole-gripping safety binding and of the cross-country skiing shoe with lateral inclination, such as referred to in the invention;

Figure 3 shows the side view of the safety binding referred to in the invention;

Figure 4 shows the side view and the front view of the safety binding base, such as referred to in the invention and fixed to the ski;

Figure 5 shows the side view and the front view of the flexible part of the safety binding base, such as referred to in the invention;

Figure 6 shows the side view of the tightening element in released position;

Figure 7 shows the side view of the tightening element in gripping position;

Figure 8 shows the front view of the adjustment of the lateral inclination of the shoe – the shoe is parallel to the ski;

Figure 9 shows the front view of the adjustment of the lateral inclination of the shoe – the shoe is inclined with reference to the ski.

The sole-gripping safety binding including the shoe with adjustable lateral inclination for cross-country skiing, such as referred to in this invention and the assembly of the binding and the shoe, such as shown in Figure 1, consists of the binding 1, mounted on the ski 2, and of the gripping element 3 with axle 10 on the sole 4 of the cross-country skiing shoe 5.

The binding 1 consists of the base 6 and of the tightening element 7. The part 8 of the base 6 is fixed by screws to the ski, while the part 9 is connected with the tightening element 7. The parts 8 and 9 of the base form on each side of the ski 2 the pincers with which on gripping of the shoe 5 the base 6 holds the axle 10 that is located in the gripping element 3 of the cross-country skiing shoe 5.

The upper section of the parts 8 and 9 is shaped in the way to make a junction point in the form of letter V. On introduction, due to the depression of the axle 10 downwards, the spring 11 gets compressed and the part 9 separates. This allows for automatic introduction. Once the axle 10 is deep enough in the pincers, the part 9, due to the spring 11, moves back to the initial position, whereby the pincers close in order to grip the axle 10 and in turn the cross-country skiing shoe 5.

The tooth 12 of the part 9 is shaped in its lower section in the way to be slanting with reference to the surface of the ski 2. On powerful pressure of the axle 10 upwards to the tooth 12 the spring 11 gets compressed and the part 9 moves forwards. The axle 10 gets released from the pincers, which constitutes the safety element of the binding.

The parts 8 and 9 are bent outwards on top, which makes the introduction into the binding easier and provides for the longest possible distance between the left and the right pincers, such as to secure better lateral stability. The gripping element 3 is of conical shape so as to fit to the pincers when the shoe 5 is clamped into the binding 1. The part 8 is provided with a salient 19 that prevents from vertical movement of the part 9.

The tightening element 7 consists of the housing 13, of the spring 11, of two levers 15 and of the tightening lever 16. The housing 13 is provided on each side with an oblong hole 17 where the axle 18 can move. The spring 11 is on one end connected to the axle 18 and on the other end to

the part 9 of the base 6. The levers 15 are on one end connected to the axle 18 and on the other end to the tightening lever 16. The tightening lever 16 is connected with the housing 13 through the bearings. Once the tightening lever 16 is in its lower position, the axle 18 is shifted backwards, the spring 11 is stretched and pushes the part 9 of the base 6 backwards. The parts 8 and 9 form closed pincers and hold the axle 10 or they are ready for automatic introduction. Once the tightening lever 16 is in its upper, lifted position, the axle 18 moves forwards, the spring 11 is released and pulls the part 9 of the base 6. The parts 8 and 9 of the base 6 form yawning pincers and do not hold the axle 10 any more. The cross-country skiing shoe 5 is not clamped into the binding 1 and may separate from the binding 1.

The adjustment of the lateral inclination is effected in the way that the gripping element 3 is not straight on top, but slightly conical. In the centre it is connected with the sole 4 through the pivot 20. The axle of the pivot runs lengthwise along the shoe.

The gripping element 3 turns around the axle of the pivot 20 for a small angle due to its conical shape. Accordingly, the cross-country skiing shoe 5 can get inclined with reference to the upper surface of the ski 2. The gripping element may be fixed to the desired angle with the screws 21. The gripping element 3 may also not include any pivot, so that it is fixed to the sole 4. Such version does not allow for adjustment of the lateral inclination, but the cross-country skiing shoe 5 is inclined for a specific

angle that may change with reference to the shape of the gripping element 3.

Under the heel of the cross-country skiing shoe, there is located the distance piece 22 that provides for correct inclination of the shoe 5 with reference to the ski 2 in the stable heel position.

Below the front part of the sole, there is located the flexor 23 that prevents from jerky transition from the stable heel position to the stable toe position.

Due to the shifting of the gripping point below the sole to the point where the push-off is the most powerful, the last phase of the push-off improves as soon as the heel of the cross-country skiing shoe is lifted. In this phase the cross-country skier no more pushes off on his toes, as with front clamping bindings, but pushes off from that point in the sole where the push-off is the most powerful and accordingly better. Another advantage of the shifting of the gripping point below the sole lies in minor fatigue of the sole muscles, because one does not need to push off on his toes.

The sole-gripping safety binding including the shoe with adjustable lateral inclination for cross-country skiing, such as referred to in the proposed version of this invention, allows in the last push-off phase the lifting of the heel of the shoe 5, while the shape of the shoe 5 remains identical to the existing one. Due to its lifted position above the ski 2 and due to the gripping point located below the sole 4, the shoe 5 follows the

principle of a swing. In one's upright position, the centre of gravity is located behind the gripping point, therefore the shoe 5 is stable in its heel position, with the heel of the shoe touching the ski. On one's bending forward or on lifting one's heel, the centre of gravity moves forwards from the gripping point towards the front of the shoe 5. At such moment the shoe 5 assumes a stable toe position in which the heel of the shoe is lifted and the shoe 5 touches the ski with the toes part. In order to avoid any jerky transition from the stable heel position to the stable toe position there is the flexor 23 mounted below the front part of the shoe. The more the centre of gravity moves forwards from the gripping point, the more the flexor gets compressed due to greater torque.

The axle 10 on the gripping element 3, that serves for clamping of the shoe 5 into the base 6 of the binding 1, is fixed to the shoe 5 at the centre and not on both ends as used to be the case with the bindings known hitherto. Therefore the base 6 grips the axle 10 on both free ends and not in the centre as before. The axle 10 is gripped on a longer length, which results in greater lateral stability.

The cross-country skiing shoe 5 allows for adjustment of the lateral inclination, which is particularly relevant with the skating technique of cross-country skiing. In the push-off phase it is favourable if the shoe is turned outwards with reference to the ski, wherefore the edge of the ski offers better support for the push-off. The possibility of setting the lateral inclination is positive because of different requirements depending on

different snow conditions. The harder the snow, the greater inclination is required for a good support to the push-off. The adjustment of the lateral inclination on the cross-country skiing shoe 5 is better than the adjustment on the ski 2, because this solution allows for exchange of the skis 2 from the left to the right foot and vice versa, which is not possible in case of adjustment on the ski 2, because such adjustment is only made for one leg.

In spite of greater distance between the ski 2 and the shoe 5, which allows for lifting of the heel of the shoe 5, the lifting is still more limited than with bindings gripping at the front where the shoe theoretically allows for turning around the axle for at max. 90°. This could be fatal in case of fall, therefore the binding referred to in this invention also includes a safety element.

PATENT CLAIMS

1. The sole-gripping safety binding including the shoe with adjustable lateral inclination for cross-country skiing,

characterized in that

the gripping point of the shoe (5) is shifted from the tip to the centre of the sole (4) of the shoe (5), whereby the sole (4) is lifted above the ski (2).

2. The sole-gripping safety binding including the shoe with adjustable lateral inclination for cross-country skiing, according to claim 1,

characterized in that

the conically shaped gripping element (3) with the axle (10), such as provided on the sole (4) of the shoe (5), is shifted towards the centre of the sole (4) and is under the heel section of the sole (4) provided with a distance piece (22), while under the toes section of the sole (4) there lies the flexor (23), whereby the axle (10) makes a grip with the base (6) of the binding (1) and the part (9) of the base (6) is connected with the tightening part (7) of the binding (1).

3. The sole-gripping safety binding including the shoe with adjustable lateral inclination for cross-country skiing, according to claims 1 and 2,

characterized in that

the part (8) of the base (6) is fixed by screws to the ski (2), while the part (9) is connected with the tightening element (7).

4. The sole-gripping safety binding including the shoe with adjustable lateral inclination for cross-country skiing, according to claims 1 through 3,

characterized in that

the upper section of the parts (8,9) of the base (6) is shaped in the way to make a junction point in the form of letter V, on top they are bent outwards, whereby the part (9) is provided with a tooth (12), shaped in its lower section in the way to be slanting with reference to the surface of the ski (2).

5. The sole-gripping safety binding including the shoe with adjustable lateral inclination for cross-country skiing, according to claims 1 through 4

characterized in that

the tightening element (7) consists of the housing (13), of the spring (11), of two levers (15) and of the tightening lever (16) whereat the housing (13) is provided on each side with an oblong hole (17) where the axle (18) can move, the spring (11) is on one end connected to the axle (18) and on the other end to the part (9) of the base (6), the levers

(15) are on one end connected to the axle (18) and on the other end to the tightening lever (16) and that the tightening lever (16) is connected with the housing (13) through the bearings.

6. The sole-gripping safety binding including the shoe with adjustable lateral inclination for cross-country skiing, according to claims 1 and 2,

characterized in that

the gripping element (3) is on top slightly conical and in the centre through a pivot (20), whereof the axle is parallel to the shoe (5), connected to the sole (4) with the screws (21) tightened into the gripping element (3).

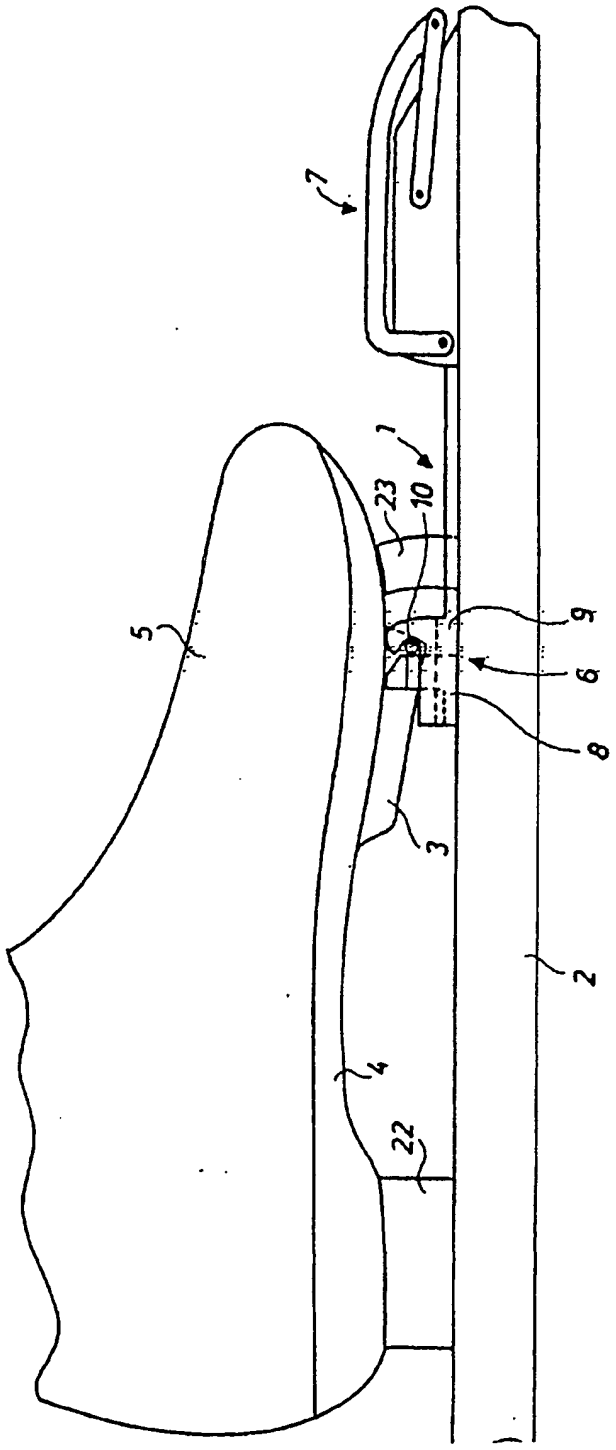

FIG. 1

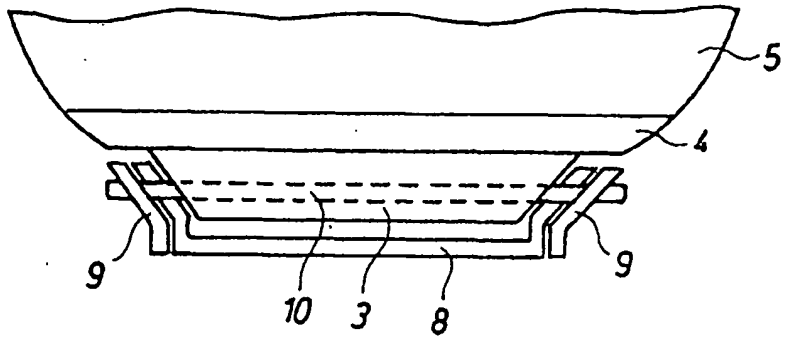

FIG. 2

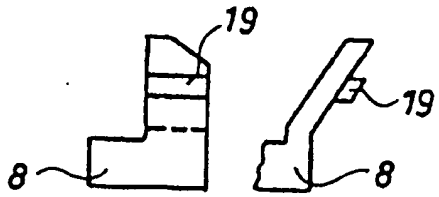

FIG. 3

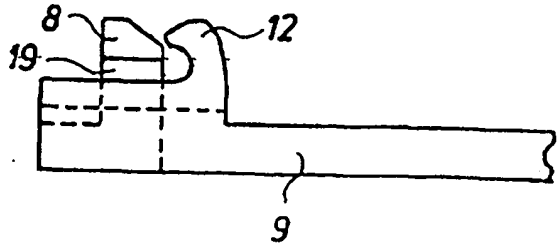

FIG. 4

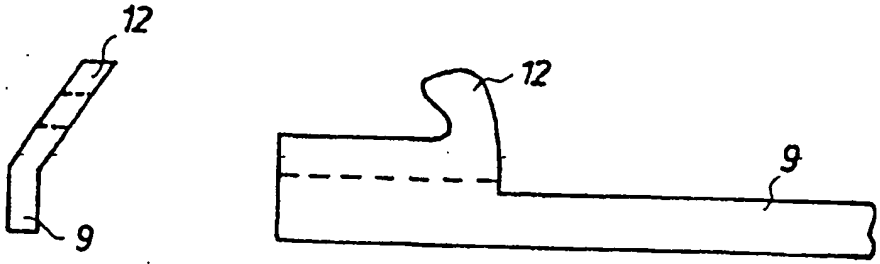

FIG. 5

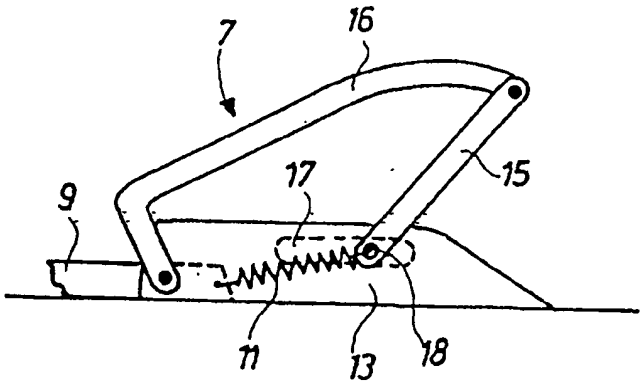

FIG. 6

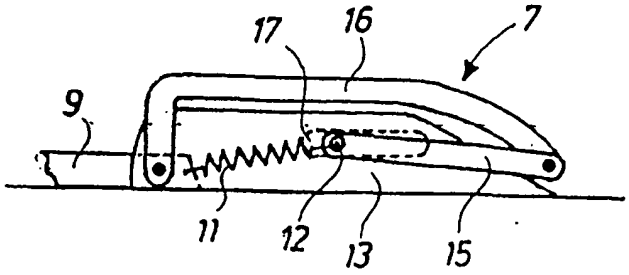

FIG. 7

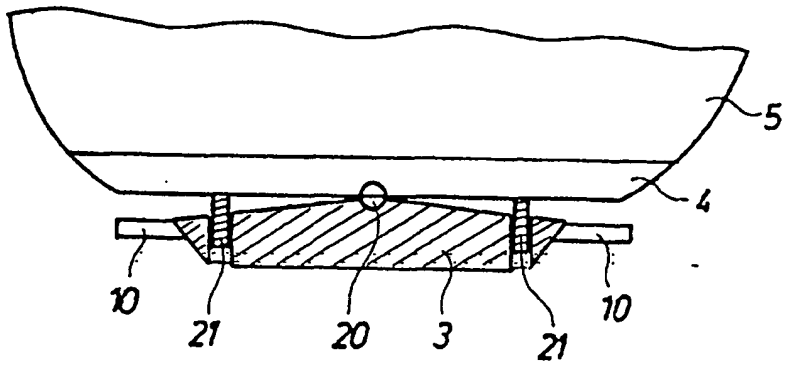

FIG. 8

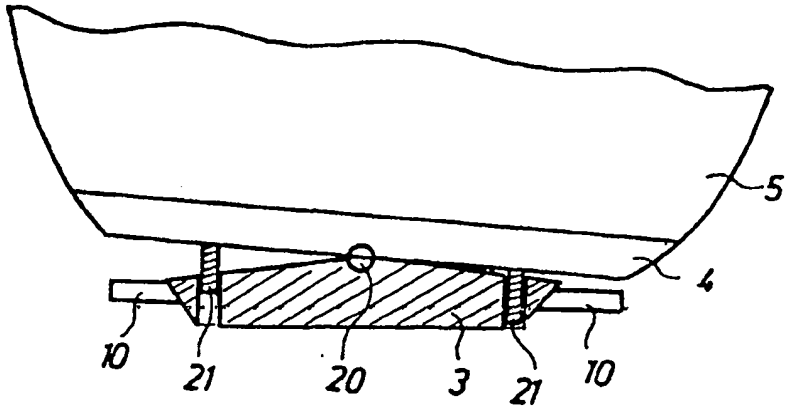

FIG. 9